Northern Rhodesia

Ministry of African Agriculture

ANNUAL REPORT

of the

DEPARTMENT OF AGRICULTURE

for the Year 1959

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CONTENTS

PART I.—AGRICULTURE IN THE TERRITORY

	Paragraphs
INTRODUCTION:	
Review of the Year	1–5
PRODUCTION:	
Subsistence	6
Maize	7–11
Groundnuts	12–14
Other Grains	15–18
Pulses	19
Cassava	20
Vegetables and Fruit	21–22
Sugar cane	23
Tobacco	24–25
Cotton	26
Coffee	27
Livestock	28–29

PART II.—ADVISORY SERVICES

ORGANISATION:	
Department of Agriculture	30–32
Board of African Agriculture	33
Natural Resources Board	34
S.A.R.C.C.U.S.	35
Third Inter-African Soils Conference	36
F.A.O. World Census of Agriculture	37
STAFF	38–40
EDUCATION AND TRAINING	41–42
ADVISORY METHODS	43
Agricultural Shows	44
Assistance to Farmers	45
IMPROVEMENT OF FARMING METHODS:	
African Farming Improvement Schemes	46–48
Peasant Farming Scheme	49–53
Livestock Improvement Scheme	54–55
SOIL CONSERVATION:	
Field Works	56–58
Village Conservation Schemes	59–61
REGIONAL PLANNING	62–64
CROP INTRODUCTION	65–66
LIVESTOCK DISTRIBUTION	67–68
SEEDS, FERTILISERS AND FARM EQUIPMENT	69
IRRIGATION	70
FARM MECHANISATION	71

PART III.—INVESTIGATIONAL WORK

GENERAL	72–73
SOIL SCIENCE AND SURVEY	74–76
GRASSLAND RESEARCH	77–79
PLANT BREEDING	80
Groundnuts	81–82
Pulses	83
Wheat	84
Other Grains and Oilseeds	85–87

PART III.—INVESTIGATIONAL WORK—(*continued.*)

	Paragraphs
Agronomy:	
Soil Fertility	88
Cotton	89
Tobacco	90
Plant Pathology	91
Irrigation and Drainage	92–93
Animal Husbandry	94–97
Chemistry	98–99
The Farm at Mount Makulu	100

CONCLUSION AND APPENDICES

Conclusion	101
Appendix I	Crop Production.
Appendix II	Climatic Records.
Appendix III	Staff.
Appendix IV	Legislation affecting African Agriculture.
Appendix V	Publications.
Appendix VI	African Farming Improvement Funds.

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE FOR THE YEAR 1959

PART I.—AGRICULTURE IN THE TERRITORY

INTRODUCTION

Review of the Year

Under the new constitution of the Territorial Government a separate Ministry of African Agriculture was established after the general election in March, and Mr. E. M. L. Mwamba, formerly Chief Councillor to the Bemba Superior Native Authority, became the first Minister. To his portfolio were allocated the departments of Agriculture and of Co-operatives and African Marketing, together with responsibility for African animal husbandry which was transferred from the Department of Veterinary Services.

2. Responsibility for services to European farmers has been with the Federal Ministry of Agriculture since the beginning of 1956 and this report is concerned only with African agriculture in Northern Rhodesia. Liaison with the Federal Government is maintained through the Standing Committee on Agricultural Production and the Research Advisory Committee, on both of which the three territorial governments as well as the Federal Government are represented, and the Agricultural Marketing Council to which the governments of the Federation and Southern and Northern Rhodesia each appoint an official observer. Liaison between the various territorial ministries concerned with natural resources is provided by the Natural Resources Board and its committees, on which also the Federal Government is represented by the Regional Director of Conservation and Extension in Northern Rhodesia.

3. The 1958–59 season was generally favourable for crop growth. Rains began early and were adequate in mid-season but ended abruptly. In most parts of the Territory the total rainfall for the season was below average, but drought occurred only in a few localised areas and there was no serious flooding along any of the major rivers. Rainfall figures for a few selected centres are given in Appendix II. Food production was sufficient for requirements in most areas and satisfactory surpluses of maize, groundnuts and tobacco came on the market. Grazing conditions were good following the early start of the rains, but an unusually prolonged dry season began to have an adverse effect from the middle of 1959 and water supplies dwindled towards the end of the year as the onset of the new rains was delayed.

4. Farmers began the year financially at a low ebb as a result of the disastrous harvest of 1958. The better seasonal conditions of 1959 permitted some recovery, but there was a decline in prices for some of the main products. Maize, which had realised 41*s*. 6*d*. per bag of 200 lb. delivered to the Grain Marketing Board in the previous season, brought only 36*s*. 9*d*. and grading was made more stringent in order to improve the standard of exports. Groundnuts bought by the Grain Marketing Board remained at 79*s*. per bag of 180 lb. kernels and prices for groundnuts exported from the Eastern Province recovered from the previous season's decline. More competitive conditions were experienced by the European flue-cured tobacco growers and there was a marked fall in the prices on the Salisbury auction floors of some of the lower grades of leaf. Difficulties in cattle marketing caused by the abandonment of the informal agreement under which the butchers had purchased all slaughter stock offered at prices for weight and grade indicated by the Cattle Marketing and Control Board continued, and butchers bought only to meet day-to-day requirements at prices approximating to the indicated prices which had been fixed in 1956. Arrangements for the Cold Storage Commission of Southern Rhodesia to extend its facilities to this Territory were completed by the end of the year.

5. There were no significant changes in the establishments employed on advisory services to agriculture during the year, and the reduction made in the budget of the department as a result of lack of funds in 1958 remained in force. A small allocation of funds and staff for animal husbandry work was transferred from the Department of Veterinary Services. There was a marked upsurge of interest in agricultural services by the native authorities, and during the latter part of the year a number of requests were made to the newly-formed Ministry of African Agriculture by the Provincial Administration for additional staff, most of which could not be met because of financial stringency. Government schemes for improved farming and peasant farming made excellent progress, and a comprehensive regional planning scheme was begun in an over-populated valley in the main African maize producing area where soil erosion had become severe. Nearly 5,000 farmers were practising improved methods in official schemes covering some 80,000 acres of cultivated land. Research carried out at the Central Agricultural Experiment Station at Mount Makulu near Lusaka and in animal husbandry at the Veterinary Research Station at Mazabuka made good progress and several scientific papers were published. The Chief Research Officer, Mr. A. N. Prentice, was appointed to be a member of the newly-constituted Agricultural Research Council of Rhodesia and Nyasaland which was established during the year under the chairmanship of Sir Ronald Prain,

PRODUCTION

Subsistence

6. The bulk of the African agricultural production of the Territory does not enter the money economy, being consumed by the families, kinsmen and labourers of the producers. Within the subsistence economy there is exchange of goods through transfers of food from those who have had a good harvest to others who need it, in discharge of kinship obligations or in return for labour services, barter or cash. All produce that is not sold to marketing boards, Government agencies or traders is classified as subsistence production. The Central African Statistical Office has made an estimate of the value of subsistence production by applying what little information exists about the consumption pattern of rural Africans in Southern Rhodesia to the other territories of the Federation with adjustments for differing price levels and populations. According to this estimate the total value of subsistence production of the African population of Northern Rhodesia in 1958, at the current market values of food, fuel and housing, was £21.8m. The total value of agricultural and pastoral production entering the money economy in that year, defined as the gross value of European agricultural production plus sales of agricultural produce by Africans to marketing boards and other buying agencies and traders, was estimated at £4.8m., of which £4.1m. arose from production on European farms and £0.7m. was attributable to Africans. This figure is abnormally low because of the poor season, and in the two immediately preceding years much higher values were achieved, £8.1m. being recorded in 1957 and £7.3m. in 1956. The figures are useful as indications only, and that for subsistence includes fuel and housing as well as food; but it does serve to show how large a part is played by African subsistence production in the total agricultural economy of the Territory.

Maize

7. Maize is the main commercial grain and the staple food of the urban African and a large rural population in the Southern, south Central and Eastern Provinces. It is important also in Barotseland where it supplements the staple cassava, and in other parts of the Territory is tending to oust the traditional staples as the main food purchased by employed Africans and institutions. The market requirement within the Territory is estimated to be about 130,000 short tons or 1,300,000 bags of 200 lb. Most of the commercial production arises on the European farms and adjoining African areas in the lower Kafue basin along the railway line in the Southern and south Central Provinces, with an important contribution from the southern parts of the Eastern Province. Marketing in these areas is controlled by the Federal Grain Marketing Board, which buys all maize produced within the controlled areas which is offered for sale (except maize bought by Africans and by missions for their own requirements), and all maize brought into the controlled areas from outside. All towns and districts along the railway line are included in the controlled areas.

8. Growing conditions were good in the 1958–59 season, and although the rains ended prematurely good yields were obtained by those who had taken advantage of the early start of the season to get the crop in promptly. Total production was sufficient for local requirements and provided a small exportable surplus. European farmers sold just over a million bags (973,000 bags of white and 53,000 bags of yellow maize), a crop exceeded only by the record 1957 harvest. The African production on the line of rail of 475,000 bags has been exceeded several times before. This must be rated a disappointing result for the season and demonstrates the relative inability of the African farmer to get his crop in early and his consequent vulnerability to a premature end of the rains. Sales in the Eastern Province were well below expectation: surplus production had been estimated to exceed 100,000 bags of which it was thought that 70,000 to 80,000 would be marketed; but a sharp decline in price, the introduction of grading and the after-effects of the disastrous 1958 harvest all probably contributed in some measure to the strong resistance which kept sales down to 50,000 bags, of which nearly 40,000 were sent to line of rail. Outside the controlled areas small quantities were sold to local traders, co-operative societies and other agencies. In the Southern Province some 12,000 bags went from Namwala to Gwembe. In the Northern Province, which has long been dependent on imports of grain from Tanganyika, over 13,000 bags were marketed and no imports of grain were necessary though some 11,000 bags of roller-milled meal were imported. Details of African production marketed during the year are given in Appendix I.

9. In the controlled areas the bulk of the crop is brought to rural buying stations operated by co-operative societies or by a special rural buying agency of the Grain Marketing Board and thence transported to the Board's depots. A few traders buy as agents of the Board, and some African producers deliver direct to the Board's depots. The approximate quantities marketed by the various agencies in the controlled areas were as follows:

	Central	*Southern*	*Eastern*	*Total*
Co-operative Societies	—	89,000	53,500	142,500
Grain Marketing Board rural buyers ...	150,000	186,000	—	336,000
Traders	32,000	—	—	32,000
Direct deliveries	Not classified			5,700

10. The price paid to the producer on delivery to the Board is fixed annually by the Federal Minister of Agriculture under the provisions of the Grain Marketing Act and takes account of exports from the whole area to which the Act has been applied, i.e. all Southern

Rhodesia and the controlled areas of Northern Rhodesia. The prescribed price in 1959 was 35*s.*, and the Board's selling price for local consumption was 43*s.* 3*d.* on line of rail. A second payment of 1*s.* 9*d.* was made at the end of the year as a result of favourable export realisations, bringing the total payment to 36*s.* 9*d.* per bag. This price was for Class A maize delivered to the Board's depots, and was subject to a deduction of 6*d.* for Class B and 1*s.* 6*d.* for Class C maize. Further deductions were prescribed to cover handling and transport to the Board's depots from rural buying stations and levies to the African Farming Improvement Funds. Last year the total payment for Class A maize delivered was 41*s.* 6*d.* The price paid to African producers at rural buying stations on the line of rail areas fell from 30*s.* for all grades of maize in 1958 to 27*s.* 6*d.*, 27*s.* and 26*s.* for Classes A, B and C respectively, and in the Eastern Province from 16*s.* 6*d.* to 12*s.* with no differentiation for grading. Details of the deductions authorised for maize bought by the Board or its agents during the year beginning 1st May, 1959, are as follows:

AFRICAN GRAIN MARKETING DEDUCTIONS, 1959

	Line of Rail		*Eastern Province*		
	s.	*d.*	*s.*	*d.*	
Handling	3	0	8	6	(maximum)
Transport	3	0	13	0	
Levy to Improvement Funds	1	6	1	6	
Second payment (credited to Improvement Funds) ...	1	9	1	9	
Price at rural buying depot ...	27	6	12	0	
Price delivered to Board ...	36	9	36	9	

11. Grading of maize which had been introduced for the first time into Northern Rhodesia in 1958 was made more stringent in 1959 because of the demand for improved quality by local millers and more particularly to secure the best possible prices for exports. For Class A maize the maximum content of defective grain (which includes discoloured, shrivelled and damaged grain and coloured grains in white or yellow maize) was reduced from 8 to 5 per cent., of which not more than 2 per cent. to consist of coloured grains; and the maximum tolerances for chipped grain, insect damage and extraneous matter were also tightened. For Class B the limits of defective and coloured grain were 10 and 4 per cent. respectively and for Class C 20 per cent. defective with no limit within this on the percentage of coloured grains. This year grading was carried out by simple inspection at the rural buying stations in the Southern and Central Provinces where the price paid was related to the grade bought. This was a change from the previous year, in which maize had been bought ungraded at a flat price at rural buying stations, but was graded on being taken in at the Grain Marketing Board's depots, price penalties being absorbed by the African Farming Improvement Funds. A good deal of publicity had been carried out among producers. Sales of improved seed had been organised and training courses given to the extension staff and the capitaos in charge of rural buying stations. The introduction of grading was in the result accomplished with little difficulty, though there was some resistance to selling in one part of the Central Province, and a marked resistance in the Eastern Province which was probably connected more with the decline in price than with grading. There was a tendency on the part of the buying capitaos to be over-severe, and this may have resulted in less maize being bought than would have been the case had there been no grading. Nearly 80 per cent. of all African-grown maize surrendered to the Board in the controlled areas was placed by the Board's graders in Class A, 18 per cent. in Class B and only slightly over 2 per cent. in Class C. This was a creditable performance on the part of producers but will be improved on.

Groundnuts

12. Groundnuts are grown in all districts of the Territory and are an important component of subsistence. In the Eastern Province a useful commercial production of high quality nuts has been built up in recent years and has found an export market for use in the confectionery trade. Marketing in this area has been in the hands of a co-operative marketing association which pioneered export, but statutory control was introduced in 1955 to facilitate expansion in suitable areas away from trading centres, and when territorial marketing control was superseded from the beginning of 1958 by Federal legislation the Grain Marketing Board assumed control. It takes a proportion of the crop to meet market requirements on line of rail, leaving the balance of the crop to be exported by the co-operative association at its own risk and profit. Since the price for the local market is based on a cheap grade of nut required in Southern Rhodesia for milling, the local market is less profitable but more stable than export to the confectionery trade. Elsewhere in the Territory only very small surpluses of groundnuts come on the market for local consumption. The North-Western Province sends some 5,000 bags of good quality nuts a year to the Copperbelt, which are surrendered to the Grain Marketing Board at 79*s.* on entering the controlled areas and have become less profitable than before when they were sold direct to the trade. At present prices the quantity that can be brought in over the long road haul from this area to the railway line is limited to the capacity of back-load transport.

13. Growing conditions in the 1958–59 season in the Eastern Province were good and an increased acreage was planted. A severe attack of rosette disease reduced yields and the total crop marketed, though substantially more than in the previous season, fell just short of the record established in 1956. There was a very large increase in the more recently developed district of Lundazi. Sales of groundnuts in the Territory in 1959 are given in Appendix I.

14. Prices on the export market recovered after the decline in the previous year. 863 long tons of graded nuts sorted by the electronic graders of the co-operative association realised an average of about £85 per long ton c.i.f., and 2,805 tons were exported ungraded at about £10 less. 1,045 tons, representing 20 per cent. of the total purchases by the association, were surrendered to the Grain Marketing Board on line of rail at 79*s.* per bag of 180 lb. delivered. In addition about 100 tons of reject nuts from the graders were sold direct to oil expressors in Nyasaland, 100 tons were sold for local consumption within the province and 200 tons were sold as seed. North-Western Province nuts were sold to the Grain Marketing Board at 79*s.* per bag delivered at the Copperbelt towns. The Board's selling price was 101*s.*, the large difference being due to cost of imports. Prices paid to African producers at rural buying stations in the Eastern Province were 51*s.* per bag for machine-shelled and 60*s.* per bag for hand-shelled nuts, and in the North-Western Province about 48*s.* for hand-shelled nuts.

Other Grains

15. Sorghum or kaffircorn is widely grown in subsistence agriculture and is in demand commercially for brewing. The requirement of the towns on the railway line for this purpose is estimated to be at least 100,000 bags (of 200 lb.) a year. Local production is very small and requirements are mostly imported from Southern Rhodesia and South Africa. As with maize, all grain for sale in the controlled areas must be surrendered to the Grain Marketing Board at prices fixed by the Federal Minister of Agriculture, which in 1959 were 37*s.* 6*d.* for Class A and 33*s.* 6*d.* for Class B kaffircorn. The Board's selling price to brewers was 50*s.* per bag.

16. Finger millet (also known as *male*, *malezi* or *rupoko*) is an important subsistence crop in the northern part of the Territory and small quantities come on the market. Growing conditions in 1959 were somewhat dry for it and not much over 1,000 bags were sold in the Northern Province. Bulrush millet (*munga*) is of diminishing importance in subsistence and there is no production for sale except for small quantities in Barotseland. The price in 1959 for both grains delivered to the Grain Marketing Board was 33*s.* 6*d.* per bag of 200 lb. The Board's selling prices were 47*s.* 6*d.* for finger millet (subject to a rebate of 7*s.* 6*d.* if purchased for use as stock feed) and 40*s.* 9*d.* for bulrush millet.

17. Rice is a fairly recent introduction grown on a small scale in parts of Barotseland and the Eastern and North-Western Provinces. Small quantities found a somewhat precarious market within the Territory. Some 3,000 bags of paddy (140 lb. to the bag) were sold in 1959, of which 1,800 were produced in the Eastern Province, 700 in Barotseland and 500 in the North-Western Province. Marketing is through traders and co-operative societies. There is no control.

18. Wheat production is negligible and practically the whole of the mounting requirement for consumption in the Territory is imported. Conditions during the wet season do not suit wheat and dry-season production is limited by the availability and cost of irrigation. The possibilities of growing wheat in the dry season on seepage sites which are fairly extensive in Barotseland are being investigated, and about 200 villagers grew a total of about twenty acres of wheat during the 1959 dry season. On the Kafue Flats wheat was grown experimentally on the Rhodesia Selection Trust Pilot Polder. There is no marketing control, but local millers buy the small quantities produced at 60*s.* per bag of 200 lb., which is slightly above the landed cost of imports but is insufficient to stimulate local production.

Pulses

19. Cowpeas and various strains of haricot and sugar beans are important subsistence crops throughout the Territory and some 3,000 bags were sold. Control of the marketing of beans by the Grain Marketing Board was lifted this year, and sales were at varying prices according to locality and the type of bean.

Cassava

20. Cassava is widely grown in the moister northern parts of the Territory as a food crop. Trade in cassava meal is mostly outside the organised marketing agencies. 8,000 bags were reported to have been sold in the North-Western Province and 7,500 in Barotseland. A good deal of exchange takes place within the subsistence economy in these areas and in the Luapula Province where it is commonly bartered for fish, and cash sales have been reported at up to 10*s.* per four-gallon tin. A shortage was experienced in western Balovale District, but supplies were obtainable in adjoining areas. In the Northern Province where it is often planted late in the season the abrupt end of the rains affected the take of new plantings.

Vegetables and Fruit

21. The production of vegetables is increasing in many parts of the Territory, mainly through dry-season cultivation of seepage or irrigated sites. The largest trade is in the Copperbelt area where it is estimated that 800 tons produced in dry-season seepage gardens were sold in the towns for a total of about £40,000. Near Lusaka there are several enterprising individuals and two small irrigation schemes producing for the Lusaka market, which however is fairly well supplied (with the limited range of vegetables grown) by both European and African growers, and returns have sometimes been low due to seasonal gluts. Production is developing in the neighbourhood of townships and other small settlements all over the Territory, and in addition to the cash sales to consumers at these centres increasing quantities are being bartered for grain and thus finding their way into the rural subsistence economy. The range of vegetables is still limited largely to cabbages, lettuces, carrots, tomatoes, potatoes, onions and shallots, and the market tends to be overstocked with these in the latter part of the dry season and short of supplies during the rains. Exceptions are Fort Jameson and other Eastern Province centres where there is a good supply all the year round. In the northern areas supply is stated to be well short of demand except at Fort Rosebery, where development is being encouraged in connection with the Nutrition Scheme.

22. Fruit production is progressing more slowly. Bananas and mangoes are widely grown and consumed in the rural areas. There is a strong demand for citrus, but the skill required to produce fruit of acceptable quality has not yet been acquired by growers, though in Barotseland oranges were taken to the line of rail by back-load air freight with apparently successful results. Strawberries are a feature at the Fort Jameson market, and pineapples, pawpaws, guavas and melons are marketed in most centres of population and sold to travellers on some of the main roads.

Sugar Cane

23. It has not yet been possible to establish a sugar producing industry in Northern Rhodesia, and as it now appears that as a result of recent and projected developments in Southern Rhodesia the Federation is heading for self-sufficiency if not more in sugar cane, no large-scale development is at the moment contemplated. Sugar cane is grown on an increasing scale by small producers using seepage or irrigated sites in various parts of the Territory and sold for chewing. Katete Show must be the largest annual market for sticks of sugar cane in the country. In some parts there is a small production of jagaree.

Tobacco

24. There was a small increase in the production of Burley tobacco by African growers in the native reserves and trust land of the Eastern Province and 29,647 lb. were sold over the Limbe auction floors in Nyasaland at an average price of 22.09*d.* per lb. The previous year's production was 19,688 lb. sold at 18.18*d.* A much larger quantity was produced on European estates by African tenants and there is still some production on European farms using " ticket " labour. The total crop marketed from the Eastern Province at Limbe was 576,822 lb. and the average price 23.58*d.* The relative merits of " tenant " as compared with " peasant " production are sometimes hotly argued. The figures indicate that at the present time the " tenant " system is bringing forth far more tobacco in the Eastern Province than " peasant " production. The table for " peasant " production over the past ten years at Appendix I suggests that if a revival is in progress after the collapse of this industry in the middle of the 1950s it is very slow, and it should be observed that it is coming largely from new areas near Fort Jameson and not from the former areas of production in Petauke.

25. Turkish tobacco production did not increase as much as had been hoped but confirmed the indications of the three previous seasons that this is a crop which can find a place in African peasant agriculture in those parts of the Territory where conditions are suitable. The total crop marketed was nearly 60,000 lb. from 750 growers who planted a total of 150 acres. A total of 49,440 lb. of the Samsun " Baffra " type was sold for an average of 34.6*d.* per lb. and 8,941 of the Soluk or " Izmir " type was sold for an average of 36.3*d.* In the previous year 45,853 lb. of Samsun had been produced by 420 growers on about 100 acres and sold at 34.25*d.* per lb. Growing conditions were generally good, but local droughts in December and January affected the production of seedlings in some areas and the early end of the rains reduced the yield of late plantings.

Cotton

26. A total of 4,000 lb. of cotton was produced by ten growers in the Luangwa Valley of the Eastern Province. Insect infestation was unusually light and an average yield of 750 lb. per acre was obtained. Quality was good, over 70 per cent. of the crop being classified in Grade I and the remainder in Grade II. The cash return in this remote area is too low to be attractive, Grade I fetching 5*d.* and Grade II 2½*d.* per lb. at rural buying stations and the average gross return per grower on his half acre plot was under £8.

Coffee

27. The number of coffee growers in the Ikumbi area of Isoka District in the Northern Province increased to seventy-seven, owning a total of 20,000 bushes. A total of 2,272 lb. of

cherry were harvested yielding 441 lb. of parchment, and the Grade A coffee was valued at £330 per ton, which is stated to be about £20 above the Tanganyika average. Growers received just over $4\frac{1}{4}d.$ per lb. for their cherry. The previous year's production was 1,488 lb. of cherry yielding 322 lb. of parchment. Green scale is the most persistent and widespread pest, but a white oil plus dieldrin spray for which the growers are charged 2*d.* per tree is now giving good control.

Livestock

28. The department assumed responsibility during the year for African animal husbandry and livestock production, but it has not yet been possible to set up machinery for the estimation of production and recording of sales. Cattle are concentrated mainly in three areas: the lower Kafue Basin in the Southern and Central Provinces, the Barotse Plains and surrounding region and the plateau areas of the Eastern Province. A small concentration exists along the Tanganyika border in the Northern Province, and there are scattered herds in various other parts of the Territory. The total African cattle population rose to 950,000 during the year, an increase of just over 30,000 or about $3\frac{1}{2}$ per cent. In the Kafue Basin area where more than half the cattle are to be found oxen are extensively used for draught and play a very important part in maize production. Sales from this area to licensed butchers rose to nearly 20,000 head which is about 4 per cent. of the total cattle numbers in the area. This is about half the total sales of cattle to butchers, European production contributing nearly 20,000. The requirement is about 70,000, the balance being imported. African sales were higher than the average of recent years as would be expected after so bad a cropping season as 1958. No data are available of numbers of cattle slaughtered for consumption within the subsistence economy. Sales of cattle from Barotseland to the Livingstone abattoir were interrupted in 1959 as the Cold Storage Commission of Southern Rhodesia, which took over from the private firm which had formerly done the buying in Barotseland, were not able to conclude an agreement with the Paramount Chief before the rains started. Elsewhere in the Territory local sales take place for consumption in the rural areas and townships.

29. Pigs in African ownership are confined to a few areas, mainly in the Eastern Province and sales to butchers are very limited. Sheep and goats are widely distributed, but in small numbers, and are consumed almost entirely within the subsistence economy. Poultry are kept in all parts of the Territory and there is a sizeable trade in eggs and table birds between African farming areas along the line of rail and the Copperbelt towns.

PART II.—ADVISORY SERVICES

ORGANISATION

Department of Agriculture

30. The Department of Agriculture is charged with the organisation of scientific and technical services to give effect to the policy of the Ministry of African Agriculture and especially to ensure—

(*a*) the production of that part of the food requirements of the people of the Federation which it is in the national interest to produce in the African areas of Northern Rhodesia;

(*b*) the efficient use of the natural resources employed in agriculture and their conservation; and

(*c*) attainment of a reasonable standard of living for all dependent on African agriculture.

31. The department works on the four levels:

(*a*) Agricultural Assistant or Agricultural Capitao in the village in direct contact with the African farmer;

(*b*) Agricultural Officer or Agricultural Supervisor at district or station headquarters;

(*c*) Chief Agricultural Officer or Provincial Agricultural Officer in charge of a group of districts corresponding generally with an administrative province; and

(*d*) the small headquarters staff and specialist officers whose duties extend (within the limits of practicability) over all parts of the Territory.

The science specialists are stationed at the Central Agricultural Research Station at Mount Makulu near Lusaka except for two engaged on animal husbandry and grassland investigations at the Veterinary Research Station at Mazabuka. The Agricultural Economist and Assistant Tobacco Adviser are stationed in Lusaka. An officer of the advisory staff charged with special duties as a publicity officer is attached to headquarters and for convenience stationed at Mount Makulu. The specialists at Mount Makulu are investigators in applied science whose function is the application of research in support of the advisory services. Research, as distinct from the local application of research to African agriculture, is the responsibility not of this ministry but of the Federal Ministry of Economic Affairs and the Agricultural Research Council (of which the Chief Research Officer is a member).

32. Some changes were made in the organisation of the department following the creation of the new Ministry. The responsibilities of the Director of Agriculture changed somewhat

with the creation of the new post of Secretary to the Ministry, but the extent of this change had not been fully resolved by the end of the year. A committee has been appointed by Government to consider the reorganisation made necessary by the new form of government. Meanwhile the Director remained the professional head of the department responsible to the Secretary for the technical services of the Ministry. The Senior Executive Officer who had filled the former post of Secretary to the department took charge of establishment matters at Ministry headquarters, and the department's accounting staff were absorbed into the Ministry under a Finance Officer. The Secretary to the Ministry took the place of the Director as Chairman of the Board of African Agriculture and as a member of the Federal Standing Committee on Agricultural Production and also assumed responsibility for representation on the Southern African Regional Committee for the Conservation and Utilisation of the Soil. The Acting Director became a member of the Board of African Agriculture and remained a member with statutory duties of the Natural Resources Board and its Regional Planning, Education and African Affairs committees. The Chief Research Officer continued as a member of the Federal Standing Committee on Agricultural Production and the Research Advisory Committee and was appointed during the year to be a member of the newly-formed Agricultural Research Council for Rhodesia and Nyasaland. He also took part in various *ad hoc* activities in co-operation with the Federal Government in connection with the F.A.O. International Seeds Year and an investigation into the cotton industry in the Federation. The Acting Director took part in a tour of the red locust outbreak areas organised by the International Red Locust Control Service prior to the meeting of the council at Lourenco Marques in July, and he and Mr. E. H. K. Mudenda were nominated to represent Northern Rhodesia on the Council of the Chibero Agricultural College, which is now being established near Salisbury in Southern Rhodesia.

Board of African Agriculture

33. The Board of African Agriculture met once during the year and discussed animal husbandry in African areas, the African Farming Improvement and Peasant Farming schemes, farm mechanisation, conservation, research plans and questions concerned with the marketing and prices of agricultural products. The unofficial members, Mr. U. J. Moffat, O.B.E., Chiefs Mwanjawanthu and Mwanachingwala and Messrs. Aaron Mwanachilenga and Amos Walubita made collectively an outstanding contribution to the discussion.

Natural Resources Board

34. The department received valuable co-operation from the Natural Resources Board which met regularly through the year and showed increasing and effective interest in the problems of the African areas. A committee of the Board was formed to advise on African affairs with the Secretary to the Ministry of Native Affairs as its chairman. The main objects of this committee are to assist African farmers to achieve maximum production from the land and full conservation of that land, and for this purpose to co-ordinate at provincial level the provision of technical advice, finance and planning. Provincial committees on natural resources were formed in all provinces outside the Barotseland Protectorate as sub-committees of provincial teams and a review of the conservation problems in each province was undertaken by these committees. Finance was provided for the first stage of a regional plan in the Ngwezi Valley in Mazabuka district. Conservation field days for teachers were organised under the auspices of the Board at Kitwe, Ndola and Broken Hill with the co-operation of officers of the department and of the Department of Conservation and Extension of the Federal Ministry of Agriculture. The Young Farmers' Club movement sponsored by the Board extended its activities to African secondary schools. A map showing the incidence of the weed *Lantana camara* over the Territory was prepared for the Board in collaboration with the Federal department.

S.A.R.C.C.U.S.

35. The Southern African Regional Committee for the Conservation and Utilisation of the Soil did not meet during 1959, but a sub-committee of which Mr. C. W. Lynn, M.B.E., Director of Agriculture, was the convener, met at Pretoria in June and produced a report on agricultural extension techniques employed in African agriculture throughout the region.

Third Inter-African Soils Conference

36. The Soil Chemist of the department was a member of the Federal delegation to the Third Inter-African Soils Conference held under the auspices of C.C.T.A. at Dalaba in the Republic of Guinea in November. He also attended a meeting of the Council of Management of the Inter-African Pedalogical Service at Conakry just before the conference.

F.A.O. World Census of Agriculture

37. Arrangements have been made for the department to participate in the F.A.O. World Census of Agriculture in 1960–61, and plans have been discussed with the Central African Statistical Office for a survey which will be carried out by officers of the advisory staff under the supervision of the Statistical Office.

STAFF

38. The year 1959 saw a welcome increase in the senior staff through the filling of vacancies for professional officers. At the end of the year there were twenty-seven Agricultural Officers in the field out of a total establishment of thirty-seven, and there were seven probationers in training overseas. Of the twenty-seven men employed, seventeen were on their first tour of service in Northern Rhodesia, a fact which emphasises the lack of experience, though seven of the seventeen had previous tropical service. The new arrivals this year included two Agricultural Officers on transfer from British Somaliland and six Agricultural Officers and a Pasture Research Officer on completion of post-graduate training. An Agricultural Economist was appointed in December on secondment from the Ministry of African Education with a view to transfer to this Ministry. A local African, Mr. I. H. Muchangwe, completed successfully the D.T.A. course at the Imperial College of Tropical Agriculture and joined the advisory staff as an Assistant Professional Officer. The department lost the services of Mr. J. Wilson, Chief Research Officer, who accepted an appointment as Director of the South African Sugar Research Institute, and Mr. J. H. Rhodes, Agricultural Officer, on secondment as Principal Agricultural Officer in Basutoland. There were no retirements but three Agricultural Officers resigned. Mr. A. N. Prentice, Chief Agricultural Officer, was appointed Chief Research Officer and Mr. A. T. Wilson, Agricultural Officer, was promoted to Chief Agricultural Officer. Mr. C. W. Lynn, M.B.E., Director of Agriculture, was appointed to act as Secretary to the Ministry of African Agriculture at the end of June, and Mr. C. E. Johnson acted as Director. Two specialist officers transferred to the Ministry from the Department of Veterinary Services in September, and two further professional posts were added to the departmental establishment for animal husbandry services.

39. The Division II staff was increased by transfer of three Livestock Officers and three vacant posts from the Department of Veterinary Services for animal husbandry work, and eight Agricultural Supervisors were recruited to make good losses, two of them on special terms for Kariba resettlement. At the end of the year there were three vacancies on the departmental establishment and a further three on the temporary establishment for Kariba resettlement and the Northern Province development scheme. Recruitment on the terms offered became very difficult both locally and in the United Kingdom and proposals for improvement are under consideration. Mr. J. Thomson transferred to the Information Department on promotion as an Information Officer, and Mr. A. W. Gow was seconded to the Forests Department for a special beeswax project.

40. Twenty-four African Agricultural Assistants successfully completed the training course at the Monze Agricultural Training School and were appointed to the staff of the department. Twenty-four African Veterinary Assistants, two Veterinary Orderlies and a Stockman were transferred from the Department of Veterinary Services to perform some of the animal husbandry activities taken over. It was not possible owing to the requirements of animal health to transfer sufficient staff to deal with all the animal husbandry work, and much of it had to be absorbed by the existing agricultural staff. The establishment of African Assistants was increased on account of this and there was a further increase offset by a corresponding reduction in Agricultural Capitaos. At the end of the year 343 African Assistants (including Veterinary Assistants) were employed out of a total establishment of 397 and 220 Agricultural Capitaos out of 228. Details of the staff are given in Appendix III.

EDUCATION AND TRAINING

41. With the closing of the former Agricultural Training School at Lunzuwa and the increasing demand for agricultural staff the training facilities have become insufficient to replace annual losses and fill the vacancies at present existing within a reasonable period of time. It is desirable also to replace a proportion of the Agricultural Capitaos as they retire with trained assistants, and there is a continuing demand for the transfer or secondment of men trained in agriculture for service with the Native Authorities. The Agricultural Training School at Monze was designed for an annual intake of about thirty to thirty-five and this normally produces twenty to twenty-five trained assistants after the two-year course. The intake was raised to forty-five in 1959, using makeshift buildings to accommodate the increase, and plans have been made to enlarge the school. Standard VI is the minimum educational requirement for entry, but this is now being raised gradually to Standard VIII. There is also a need for facilities for in-service training to European staff in advisory techniques, farm planning, surveys, conservation lay-out and other aspects of their work which are developing fast. A number of officers attended short courses in planning and conservation arranged by the Federal Department of Conservation and Extension in Salisbury, and these have been most valuable.

42. School gardens have a place in introducing to children the elementary principles of modern production and conservation and in stimulating interest in agriculture and natural resources. The approach is mainly through nature study and the school vegetable garden, and several hundred primary schools in all parts of the Territory have gardens run with assistance from the advisory staff. A few upper schools have small farms with cattle. Young Farmers' Clubs were introduced during the year at some African secondary schools.

ADVISORY METHODS

43. Personal contact and practical demonstration and assistance continue to be the keys to successful advisory work. Farmers' Days held at departmental stations and demonstration plots and on the farms of the best African farmers are increasing in popularity and effectiveness and people travel considerable distances to attend them. Visits by parties of chiefs, councillors and other influential Africans to experiment stations, demonstrations, produce markets, etc. are proving to be most useful, and the work of the Native Authority Development Centre at Chalimbana near Lusaka in running courses which include organised visits to agricultural activities is undoubtedly having a beneficial effect. The radio programme " Farmers' Notebook " is a regular feature in the African Service of the Federal Broadcasting Corporation from Lusaka, much of the material being collected by the advisory staff of the department. Farming news is a feature also in the vernacular newspapers which are printed in each province by the Northern Rhodesia Information Department. An experienced officer of the advisory staff took a short course while on leave at the Overseas Visual Aids Centre in London, and after further training with the Information Department was allocated the special duty of adapting the various aids and methods to the needs of the department, maintaining liaison with the Information Department and keeping officers in the field informed of developments of technique.

Agricultural Shows

44. Agricultural shows were held at a number of centres in the rural areas. It is estimated that 7,000 Africans and 300 Europeans attended the Katete show in the Eastern Province, which was opened by the Minister of Native Affairs, and almost as many were present at the Monze show in the Southern Province opened by the Minister of African Agriculture. Two of the smaller events, the Keembe and the Sala agricultural shows, were organised by the Native Authorities concerned. At a number of other centres where African agriculture is less developed the farming element was perhaps less conspicuous than the industrial and handicrafts sections and the sporting events, but some excellent exhibits were displayed in the produce sections, some of which won prizes in the African produce section of the Lusaka Agricultural Show.

Assistance to Farmers

45. Advisory techniques must be related to the local conditions of agriculture in each area and must be practical. In the maize-producing areas near the railway in the Southern and Central Provinces, African farming has a strong commercial element and is relatively intensive. Advisory staff here is more concentrated than in less developed areas and largely occupied with the African Farming Improvement Schemes which have been in existence for some time. Two additional Agricultural Officers and an Assistant Professional Officer were posted to the Southern Province to begin work on a regional planning scheme near Mazabuka. Further from the railway in Mumbwa, Namwala, Mkushi and Serenje districts maize becomes less profitable and more emphasis is given to crops of higher value, and to livestock. In the Eastern Province the fertile soils and industry of the people allow maize to be produced at lower cost than elsewhere and some production for sale is possible though marginal. Groundnuts of high quality are successfully produced and there are good prospects for the development of both Turkish and Burley tobacco. An Agricultural Officer was posted to Katete for tobacco development. The Peasant Farming Scheme has made progress here but is now slowing down for lack of funds. The Western Province is largely urban, and efforts are directed mainly to development of vegetable production, which increased considerably during the year and together with fruit, poultry and eggs offers the best scope for the activities of the advisory staff. A small station was established at Masaiti in the rural district and it is hoped that this will become the centre of development and administration for the small rural population. The North-Western Province is sparsely populated and its development is retarded by poor communications. The Kabompo station which had been closed because of staff shortage in 1957 was re-opened for trial development of Turkish tobacco and an Agricultural Officer was posted there during the year. The Barotseland Protectorate is also affected by difficulty of communications, and advisory services have suffered from staff shortages. The new station opened at Sesheke in 1958 had to be closed temporarily early in 1959 for lack of staff, but was re-opened towards the end of the year. An Agricultural Officer was posted to Namushakende, which had been without such an officer since the Provincial Agricultural Officer transferred to Mongu early in 1958. In the Northern and Luapula Provinces the advisory services are mainly occupied with the agricultural part of the intensive rural development plan begun in 1957. This plan made provision for four additional Agricultural Officers of whom two were supplied during the year and posted to Abercorn and Kasama, and two Project Supervisors were recruited for work in Turkish tobacco and coffee. Much attention was given to livestock development during the year and the nutrition investigation in Fort Rosebery district was continued.

IMPROVEMENT OF FARMING METHODS

African Farming Improvement Schemes

46. The purpose of the African Farming Improvement Schemes is to encourage farmers to adopt improved farming systems by means of farm planning accompanied by financial and

practical assistance and inducements. Finance is provided by the African Farming Improvement Funds derived from levies and profits on agricultural produce sold. Experience indicates that these schemes can operate successfully where cash-crop production is well established and there has been some progress towards commercial farming. They function at present in the Southern, Central and Eastern Provinces. In the Eastern Province where development is more recent than in the other two the scheme is complementary to the Peasant Farming Scheme which is designed to lift people out of subsistence agriculture into farming which has a commercial as well as a subsistence aspect. In the Central Province the Farming Improvement scheme is confined to the more developed areas and Peasant Farming is encouraged in the more backward areas, but the two schemes co-exist in one or two areas where the Peasant Farming Scheme is employed to establish farmers and the Improvement Scheme for their further development.

47. Progress in the spread of improved farming methods during the year was very good. The number of improved farmers co-operating in the schemes during the 1958–59 season who received bonuses in 1959 had grown in the Southern Province from 1,438 to 2,208, in the Central Province from 562 to 827 and in the Eastern Province from about 900 to 1,608. It is estimated that a total of 80,000 acres is now farmed under the improved systems. This represents a substantial contribution to the stability of African farm production in the Territory and the conservation of soil in African areas. The amount paid out in bonuses to these farmers was £40,500 in the Southern, £15,500 in the Central and £9,900 in the Eastern areas, a total of £66,000. In addition there was considerable expenditure on soil conservation works which are not confined to the land farmed under the improved system, although this is given priority. In the Southern Province advantage was taken of the exceptionally heavy demand for casual labour from the rural community which had been severely hit by the crop failure of 1958 to step up soil conservation, and some £60,000 was spent on construction of contour ridges, storm drains and other works from the African Farming Improvement Fund. Loans were granted to improved farmers for the purchase of implements, farm carts, fencing wire, fertilisers, livestock and other improvements from the funds in the Southern and Central Provinces (but not in the Eastern Province where there is a well-developed co-operative organisation). The amount out on loan at the end of the year in these two provinces was over £20,000.

48. The administration of these funds was placed in the hands of provincial boards by the African Farming Improvement Funds Ordinance at the end of 1957, and these completed their first full year of working in 1959. All three funds showed large deficits in their trading accounts, income being severely reduced by the poor harvest in 1958, while expenditure was increased as a result of the bigger enrolment of improved farmers and by the additional conservation work undertaken. The actual income of the funds for the year is not yet known because the Grain Marketing Board has so far been unable to produce a statement of the amount of levies collected and of expenses due by the funds to the Board. Fortunately fairly ample reserves had been built up in these funds during their period of management by the Department of Agriculture, when a run of good harvests and rising prices for produce kept income buoyant while expenditure rose slowly as interest and confidence in the scheme by the African farmers was gained. Now, expenditure is in full flood, prices for produce have declined and no run of good seasons can be expected to last for ever. The boards are very conscious of the need to balance income and expenditure in the long term and have given consideration during the year to reduction of some of the financial benefits and to limiting the period for which an improved farmer will be subsidised through cash bonuses. The Southern Province Board has led the way in this, and to ensure that the fund will be able to play its part in contributing to the capital needs of African agriculture it has appropriated a substantial amount of its reserves as a capital fund for farm and regional planning. It is abundantly clear that the African farmer in Northern Rhodesia cannot in normal times sustain the rate of capital development required to achieve efficient production and conservation out of his own savings, and that substantial financial assistance will be required. The main heads of expenditure from the funds in the 1958–59 financial year are shown in Appendix VI.

Peasant Farming Scheme

49. The Peasant Farming Scheme enables subsistence cultivators in suitable areas to become producers of small surpluses for sale by providing simple farm planning and capital for land clearing, implements and oxen. It has made its greatest advance in the Eastern Province and continues to do so. Some progress has been made also in parts of the Central Province and recently in the Northern Province. There are small groups in the Western, North-Western and Luapula Provinces and none in Barotseland. This scheme appears best to suit the needs of communities just emerging from subsistence agriculture where possibilities of cash-cropping exist and where development has not already introduced a substantial commercial element into the farming system. Finance is provided by means of a revolving fund of £260,000 derived by contributions from the Northern Rhodesia Government and the Colonial Development and Welfare Fund. The whole amount has now been committed and future finance is dependent on repayments by established peasant farmers of their initial loans. Additional finance is urgently required to sustain the expansion of the scheme until repayments become sufficient to carry the whole programme, as they will in a few years.

50. In the Eastern Province 298 new farmers entered the scheme bringing the total number to 1,906. There are two types of peasant farmer: small groups were settled on empty blocks of land to start the scheme and this continues as part of resettlement schemes for alleviating land pressure in native reserves; and individual arable holdings both in native reserves and in trust land have been developed as peasant farms without the necessity of resettlement and now far outnumber the group peasant farms. No farmer is registered as a peasant farmer unless he has a minimum holding of twelve acres and signs an agreement to farm in accordance with the rules of the scheme and to repay his initial loan within a stipulated period. In the Eastern Province there were at the end of June 491 " group " farmers and 1,415 " individual " farmers cultivating nearly 40,000 acres, and the cost of establishment repayable by the farmers had been about £230,000, an average of about £120 per farm. Average cash income for the year 1958–59 was about £40 per farm derived mainly from sales of maize, groundnuts and tobacco.

51. In the Central Province the number of established farms rose from 186 to 202, growing mainly maize, sorghum and a few pulses and vegetables. Two groups grew Turkish tobacco with success. Some of the farmers in Serenje district, where the returns from arable farming have been poor, are developing a small cattle industry to supply the local market with meat and possibly some milk.

52. In the northern area which includes the Northern and Luapula Provinces there were 231 established farms by the end of the year, distributed in every district. The Chief Agricultural Officer reports that " the economic benefits are largely latent " and that the main problems of introducing a stable agriculture to this remote area are yet to be solved. Incomes averaged about £25 per farm in addition to subsistence, the range being from £1 10*s*. to £170. Total acreage cultivated is over 1,500.

53. In the North-Western Province 31 farms were occupied of which 17 are in Solwezi district where there is some good soil and a market in the adjacent mining area of the Congo. Attention is being focused on the introduction of suitable cash crops and livestock, experiments being in progress with fruit and vegetables, Turkish and Burley tobacco and coffee. In the Western Province there are two small groups each with five established farms. Sorghum and vegetables are the main cash crops and total production on one of the groups was valued at an average of £200 per farm. A start was made in the Southern Province this year as a follow-up to Kariba resettlement, 10 peasant farms being taken up in the resettlement areas in Gwembe district.

Livestock Improvement Scheme

54. A scheme for livestock improvement was introduced experimentally in the Plateau Tonga area of the Southern Province two years ago by the Department of Veterinary Services, and its administration was transferred to this department during the year. Funds had been provided to start it by the Commissioner for Rural Development. Its object is to encourage African farmers to keep good bulls, to observe a few elementary rules of good cattle management and to sell a proportion of their cattle each year for slaughter. An annual payment is made for each approved bull kept and a bonus is paid on certain grades of cattle sold at the weight and grade sales organised by Government. The scheme has at present 225 members.

55. Weighbridges and collecting pens have been placed by the Department of Veterinary Services at a number of points in the main African cattle areas near the railway in the Southern Province, and sales are organised from time to time. About 1,500 head were sold in 1959. This scheme is being extended into other cattle areas and improved with the ultimate object of holding regular auction sales at these centres.

SOIL CONSERVATION

Field Works

56. The planning and construction of soil conservation works is a prominent feature of the African Farming Improvement Schemes. In the Southern Province over 320 miles of graded contour ridges and 17 miles of storm drains were completed, and 56 miles of contour grass strips and 32 miles of spillway boundaries demarcated. In the Central Province about 100 miles of contour ridges were constructed in the Lusaka, Broken Hill and Mumbwa districts. In the Eastern Province the advisory staff pegs level contours on which simple ridges closely spaced are made by the garden owners in the course of cultivation. Over 1,000 miles were pegged in 1959 on nearly 10,000 acres. The majority of villages in the provinces are now practising contour cultivation. In most other parts of the Territory sparse populations practising shifting cultivation do not as a rule create any grave problems of soil erosion on the cultivated lands, and contour ridging is confined to peasant farms and a few localities where steep slopes and longer cultivation periods increase the erosion hazard.

57. Water conservation by small earth dams and weirs also receives attention from the department to supplement the larger works constructed under the direction of the Department of Water Affairs of the Ministry of Land and Natural Resources, especially in cattle areas where a wide distribution of watering points aids in the alleviation of over-stocking. Work carried out during the year included the construction of two weirs in the Southern Province, maintenance and repair work on a number of older dams and weirs, and the fencing of dams for protection against damage by stock.

58. In the Barotseland Protectorate efforts continue to encourage the proper use of the soil fringing the plains and valleys where the soil moisture regime ranges over a short distance from very dry in the deep sands of the interfluves to very wet in the clays and peats of the plains and valley bottoms. Careful water control is necessary to make full use of these valuable sites, and cropping requires fine adjustment to the moisture conditions at the various levels. Although there was no serious flooding of the Zambezi this year many of the plains remained waterlogged after the big floods of the two previous years, and large areas have been thrown out of cultivation and many minor drainage schems made ineffective because of the rise in the water level. Assistance with drainage where it is practicable by means of canals, and demonstration of correct land use for these intricate soil patterns are among the main activities of the advisory staff.

Village Conservation Schemes

59. In the Eastern Province about 150 villages have had their lands laid out in orderly fashion for contour cultivation and crop rotation, including the use of a green manure crop and kraal manure where it is available. The scheme is subsidised to a small extent by the African Farming Improvement Fund to provide fertilisers. It has not been entirely successful in stabilising village agriculture in spite of the possibilities for cash-crop farming which exist in this area, and it appears from experience so far that a necessary ingredient in any programme of agricultural improvement is the drive from within which is more readily found in the progressive individual than in a village community.

60. In the North-Western Province experiments with " corridor " settlements continued, but these also show, as yet, little promise of developing stabilised agriculture, possibly for the same reasons as in the Eastern Province village scheme. The object of the corridor settlements is controlled shifting cultivation, the traditional methods being left untouched except to the extent that a village area is defined and cultivation is encouraged to move around the area in orderly sequence so that in theory there should be no need for the village to move out of the area. In practice it is not possible with customary land tenure to control the extent of cultivation so as to ensure that there will be an adequate period of regeneration before the next cycle of cultivation begins, and some of the corridors are already over-populated in terms of the carrying capacity of the land under the indigenous system of cultivation. It is too early to say yet whether agricultural improvement will be stimulated as a result of the stabilisation of the village to an extent sufficient to stabilise agriculture. Administration of some of the blocks has been taken over by the Native Authorities.

61. The chitemene control scheme in the northern areas of the Northern Province continued, with 197 of the 255 villages in the scheme now in the second cycle of cultivation. A report was made by the Principal Agricultural Supervisor, Mr. J. H. Alder, in 1958, proposing changes in the system of control and plans were formulated during the past year for two pilot schemes which will allow freedom of cultivation within the village area after protected areas have been demarcated round water courses and steep slopes.

REGIONAL PLANNING

62. Regional planning is a development from individual farm or village conservation which has been successfully introduced in recent years in the European farming areas of Northern Rhodesia. Piecemeal conservation can never be completely satisfactory. To get maximum effect schemes must be tailored to the landscape. A start was made in introducing this concept to African agriculture some years ago when a severely eroded part of the upper Kaleya River catchment was planned. Since then regional planning has been carried out in the Chipengali resettlement area in the Eastern Province, an empty block of 250 square miles, which has been utilised for resettlement from the overcrowded Ngoni reserves near Fort Jameson. So far forty-five peasant farmers and ten villages have been settled in this area which is expected to take 8,000 people. Similar work has been started on two further resettlement areas in the Eastern Province. The Rukuzie scheme is designed to resettle some 2,000 people from the adjoining Chewa Reserve on about 50 square miles of hitherto empty land north of Fort Jameson. So far fifteen peasant farmers and eight villages have been settled there. The Nyamadzi–Lupande area near Katete is 250 square miles in extent: planning was completed during the year and five peasant farmers and one village have moved in. The planning in these areas includes provision for roads, peasant farms, areas for village cultivation, grazing areas, water supplies and all necessary conservation works. It is preceded by soil survey and the aim is to site arable and grazing lands on the most suitable soil for the purpose, to align roads and locate villages so as to reduce erosion hazards to a minimum, and to develop water supplies to serve the needs of the community.

63. A similar approach is being made to the problem of development in the Northern Province. Four areas have been selected for intensive development after careful survey of land capability. In the Mungwi area near Kasama a rural township with trading stores, secondary school and various other enterprises forms the focal point of a scheme which includes a number of peasant farms, a training institute for peasant farmers, a model African dairy holding and irrigation for vegetables and fruit. The Luitikila Valley near Mpika contains perhaps the most fertile land in the province, and appears to have a considerable irrigation

potential which is being surveyed. A third area with good agricultural potential and few inhabitants at present lies south of Luwingu towards the Luena estuary and the Bangweulu water route. The fourth area scheduled for development differs from the others in carrying a relatively dense population of about fifty per square mile owning a fair number of cattle in the Saisi Valley near Abercorn. In all these areas land use is being carefully planned to make the maximum use of the available natural resources.

64. In the maize-producing areas of the Southern and Central Provinces most of the best accessible land is already heavily settled and planning has to take account of the existing pattern of use. This is a more difficult exercise than the planning of empty areas for settlement, and a modest start has been made in the Ngwezi Valley near Mazabuka where the problem is in many respects similar to that presented by the initial scheme in the Upper Kaleya catchment. Survey was carried out during the year by the Principal Agricultural Supervisor at Monze, Mr. E. G. Dabinett, a plan was drawn up and approved by the Natural Resources Board, and money was voted for Stage I of the plan which was started towards the end of the year. The plan embraces some 49,000 acres of hilly country with a resident population of about 3,500, owning 7,500 cattle and cultivating 17,500 acres. A simpler plan was carried out in a lightly populated area near Kalomo earlier in the year as a demonstration. A survey is in progress in the Sala area of Mumbwa district where it is hoped to introduce a regional plan shortly.

CROP INTRODUCTION

65. To assist evolution from subsistence to commercial farming the advisory staff has introduced various possible cash crops. Turkish and Burley tobacco, vegetables and fruit, rice, cotton, coffee and sugar cane have all been mentioned in Part I of this report. Special efforts were devoted to Turkish tobacco during the year and the post of Assistant Tobacco Adviser at headquarters, created in 1957 and held by Mr. G. B. Emslie, has fully justified itself. He has undertaken distribution of seed, supervision of nurseries to produce seedlings for sale to growers, organisation of marketing, training of staff and advisory visits in the field. Finance for the raising of seedlings, purchase of fertilisers and materials for curing and packing are now provided in African Farming Improvement areas by the appropriate African Farming Improvement Fund, and repaid by growers when the crop is sold. Additional staff for tobacco advisory work is to be recruited in 1960.

66. Other recent crop introductions are soya beans, of which about 250 bags were grown by African farmers in the Eastern Province in 1959, and sunflowers, which has been rather disappointing in the maize areas of the Southern Province where it has been under trial for two seasons.

LIVESTOCK DISTRIBUTION

67. Cattle for distribution to peasant farmers are acquired by purchase wherever suitable animals are available and are also bred on various stations where demonstration herds are kept. The herd at Irumi Animal Husbandry Station near Mkushi was taken over from the Department of Veterinary Services during the year. The large herd at Mbesuma Ranch in the Northern Province was also acquired by transfer, but there is some doubt of the suitability of this stock for distribution to peasant farmers because of the high breeding of the foundation stock and the favourable environment on this ranch by comparison with conditions on most African farms in the area. Alternative plans are under consideration for the development of commercial beef ranching in the Chambezi Flats area starting from the nucleus at Mbesuma. A ranch is being developed by the department for the Chishinga Native Authority in the Luapula Province to produce cattle for distribution or slaughter as circumstances require. A few bulls become available for distribution from these various herds and from the nucleus breeding herds of Ngoni, Barotse and Boran cattle at Mazabuka.

68. Cockerels bred in a modern hatchery of the Department of Veterinary Services at Mazabuka are distributed in all provinces by the advisory staff, and holding grounds have been set up at a number of centres for this purpose. The aim is to improve local poultry for eating, but attention is also being given to improvement for egg production.

SEED, FERTILISERS AND FARM EQUIPMENT

69. The department assists in the distribution of improved seed, fertilisers, farm carts and implements to African farmers where commercial facilities are inadequate, utilising where possible producer co-operative societies. The African Farming Equipment Company formed in 1957 to distribute farming requisites in the Central Province maize areas had a successful second year of operation, expanding its turnover to £41,000 from £18,000 in the previous year. It is financed by the Central Province African Farming Improvement Fund and operates in the southern part of the Central and northern part of the Southern Provinces. The two co-operative marketing associations in the Southern and Eastern Provinces both played a valuable part in distributing African farmers' requirements. Altogether 1,400 tons of fertiliser were bought by African farmers in 1959, consisting of 850 tons of sulphate of ammonia, 520 tons of superphosphate and about twenty-five tons of compounds for tobacco and vegetables. Maize seed was retailed in the Southern and Central Provinces to improve the grade of maize produced, and sales of ox carts, both steel-wheeled and pneumatic tyred, continued to be a special feature.

IRRIGATION

70. Two small irrigation schemes for fruit and vegetables in the Lusaka area are supervised by the department. At Chipapa Dam fifty-six growers marketed forty tons of vegetables and two tons of fruit at an average realisation of 2.4*d*. per lb., of which 1.5*d*. was paid to the growers and most of the balance absorbed in transport and marketing costs. At the newer Chaka Dam oranges, bananas and guavas have been planted and it is intended to grow vegetables all the year round. At an experimental scheme at Sumbe near Fort Jameson, three peasant farmers have been established growing sugar cane under irrigation. Another irrigation scheme for vegetables is being established at Kafushi Dam near Keembe in the Central Province.

FARM MECHANISATION

71. There are now estimated to be 135 tractors on African farms in the Central Province and 84 in the Southern. The total number in African ownership is estimated to be at least 250. The African Farming Equipment Company has made an agreement with a hire purchase firm to cover the sale of tractors to African farmers and provides a twenty-four-hour fuel service at Keembe. An investigation by the Agricultural Economist with an officer of the advisory staff experienced in machinery began with a view to assessing the problems and devising a suitable advisory programme for these farmers.

PART III.—INVESTIGATIONAL WORK

GENERAL

72. Investigational work is carried on at the Central Agricultural Research Station at Mount Makulu near Lusaka and the animal husbandry section of the Veterinary Research Station at Mazabuka, with support from one field station at Misamfu near Kasama and a number of agricultural substations which are primarily centres for advisory work. Mount Makulu is equipped with laboratories for chemistry and agricultural botany, a drawing office for aerial photo interpretation and mapping and a modern farm which provides facilities for field experimentation. The facilities at Mazabuka include extensive grazing lands, all equipment necessary for handling livestock and a large herd of cattle from which animals can be drawn for experimental work. The field station at Misamfu is being developed for field experimentation in the full-time charge of an agricultural officer who is free of advisory duties. The various agricultural stations have limited facilities for field experimentation and observation. The staff at Mount Makulu includes specialists in chemistry, ecology, soil science, crop and grassland agronomy and plant breeding and pathology. At Mazabuka there are specialists in animal husbandry and grassland investigation. Elsewhere (except at Misamfu) experiments are in charge of the advisory staff with assistance in design and interpretation from the specialists at Mount Makulu and Mazabuka. The principal aim of research is to improve yields of crops and livestock, and to this end investigate all the factors concerned in yield in order to provide information on which sound advisory programmes can be based.

73. At Mount Makulu there was an early start to the rains, and planting was a month ahead of that of the previous season. Rainfall was heavy in mid-season and the effective rains shut down prematurely, but the crop yields were good where planting was early. At the Mazabuka station rainfall was below normal, 29.74 inches being recorded, which fell mainly between late November and early March. May was abnormally hot and this, with the early cessation of the rains, turned the 1959 dry season into a hard one for cattle. Calves were weaned a little earlier than usual and all adult stock sent out to winter grazing on the Kafue Flats in August. Climatic data for selected stations appears in Appendix II.

SOIL SCIENCE AND SURVEY

74. In the Eastern Province an area of some 315 square miles was mapped in detail on a scale of 1: 20,000, air photographs being used throughout. This scale is better adapted to the detailed soil mapping required for land planning purposes than the 1: 50,000 scale used formerly. A successful attempt was made to relate the information gathered in the usual course of soil survey to the vegetation and to local agricultural practices and to relate the soil to the relief within the important group of plateau soils. The results so far confirm the hypothesis advanced by C. G. Trapnell that the major soil groups are determined by geomorphology and age, and the vegetation not only corresponds with the major soil types but where there are variations due to differences in parent material they are reflected in the vegetation. The close similarity between the territorial soil map and the vegetation-soil map has become more and more obvious during the year, and soil survey data have been sent to Trapnell for use in the revision of the vegetation-soil map for which he is responsible. Data have also been supplied to Dr. d'Hoore of Yangambi who is preparing a 1: 5,000,000 Soils Map of Africa South of the Sahara.

75. Two very different soil types on Mount Makulu were tested for differences in response to maize fertilisers. The one soil with a shallow horizon of sandy clay loam overlying sandstone gave over twenty-eight bags to the acre under the best fertiliser treatment, whereas on red clay, generally considered a superior arable soil, the best fertiliser treatment yielded only twenty-three bags to the acre. Partly on such evidence the limited area of arable land on the

station, hitherto restricted to the red clay, is now being expanded to include some of the other type. Over thirty micro-plot experiments were carried out on soils for which records from orthodox experiments were available, but results did not always show good correlation; potassium and phosphorus micro-plot responses always could be correlated with the level of these elements shown in soil analysis but the micro-plot experiment seems in general to be no better than laboratory analysis. Where laboratory analysis is not possible there may be a place for the micro-plot technique.

76. In addition to its work on soils the survey section produced maps of the distribution in Northern Rhodesia of *Lantana camara*, a woody shrub which has encroached increasingly as a bush-weed on grazing land; another showing farming systems of Northern Rhodesia based on Trapnell's classification; another of the Ngwezi river catchment in the Southern Province, an area with a major erosion problem; and mapping and photo-interpretation for land use planning in parts of the Southern, Eastern and Central Provinces.

GRASSLAND RESEARCH

77. The two major natural grassland communities, *Hyparrhenia* on the uplands, and *Setaria*-dominated pastures on the lower lying seasonally wet dambos, show generally similar trends in their natural growth cycles. Indications are that although useful grazing continues longer into the dry season on the dambos, regrowth starts no earlier at the end of the dry season than it does in the upland community. The crude protein content of the *Setarias* has proved lower than expected, and only ammonium sulphate of the treatments in a trial of the effects of nitrogen, phosphate, potash and lime significantly increased yields of dry matter and of crude protein. What has come to be accepted as the normal highly significant response to nitrogen was obtained with the grass *Eragrostis curvula* in 1958–59, but in addition phosphate gave a significant response in this, the third season of a trial; the picture that is emerging with most grassland on Mount Makulu is of a chronic shortage of nitrogen which can be alleviated only to unmask a phosphate shortage. There are signs also of a response to potassium at the higher levels of nitrogen application with Rhodes grass although not with *Hyparrhenia* which as it happens has a naturally lower content of potassium in its herbage. District trials so far as they have gone bear out Mount Makulu results in general.

78. First-season measurements from experiments on frequent defoliation at different stages of growth showed that yield of dry matter was significantly greater the later the stage of cutting, as anticipated; figures from a *Hyparrhenia* grassland area and from one of giant Rhodes grass (*Chloris gayana*) although not strictly comparable give some idea of the absolute yields which are obtainable locally.

HYPARRHENIA (H) AND RHODES GRASS (R): YIELD OF DRY MATTER AND CRUDE PROTEIN

Growth stage	*Height of cut above ground*	*No. of cuts in season*		*Total yield, pounds per acre*			
				Dry matter		*Crude protein*	
		(*H*)	(*R*)	(*H*)	(*R*)	(*H*)	(*R*)
6 in.	1 in.	5	6	1,767	2,424	187	272
	2 in.	5	6	1,093	2,359	97	264
	4 in.	9	11	1,388	1,835	126	225
12 in.	1 in.	4	4	2,412	3,079	206	261
	2 in.	4	4	3,299	2,371	297	219
	4 in.	6	6	2,038	2,902	195	296
18 in.	1 in.	2	2	3,114	3,618	209	237
	2 in.	2	3	3,940	3,024	315	294
	4 in.	3	4	2,157	3,007	204	342

Although no significant differences in yield resulted from the cuttings at various heights those plots subjected to frequent cuttings at one inch above ground level were showing signs of diminished vigour by the end of the first season.

79. The effects on animals and herbage of restricting the grazing were studied in a series of trials at the Mazabuka Research Station with indigenous cattle. The previous season's finding (recorded in the Annual Report of the Department of Veterinary Services for 1958) that cattle kraaled from 6 p.m. to 7 a.m. made slightly better liveweight gains than those on free grazing was repeated during the 1958–59 rainy season. During the dry season which followed all groups lost weight, the kraaled animals slightly more than those on free grazing. Cattle kraaled from 4 p.m. to 9 a.m. made about 10 per cent. less liveweight gain in the rains and lost about 15 per cent. more during the dry season than those not kraaled. Stocking at rates of $3\frac{1}{2}$, 8, $12\frac{1}{2}$ and 20 acres per head showed that liveweight gains during the rains were much the same at $3\frac{1}{2}$ acres as at the larger acreages, but loss in weight during the dry season increased progressively as the grazing per head was reduced below $12\frac{1}{2}$ acres. The greatest liveweight increase *per animal* was achieved at $12\frac{1}{2}$ acres per head (no further increase was gained by going up to 20 acres) but the greatest weight gain *per acre* over the three-year period of this experiment was attained at the $3\frac{1}{2}$ acres rate. A group grazed at 3 acres per head but

with part of the area planted with Napier fodder for dry season grazing and supplemented with veld hay sprayed with molasses and urea was the only group not to lose weight in the dry season, and though gains made during the rains were smaller than with the other groups the total weight gain per head and per acre over the three-year period was the highest of all groups. The two extreme stocking rates are being continued for examination of effects on the veld. Fertiliser trials on veld showed, as would be expected, a response to nitrogen, and to phosphate when nitrogen was present.

PLANT BREEDING

80. The Plant Breeders at Mount Makulu have been feeling the need of more testing sites and facilities in the provinces; improved varieties of crops such as groundnuts and cassava are reaching the stage of replacing existing stocks, but the local evidence on the measure of the improvement being effected, and on the attractiveness of the new varieties for consumption or the market, is scanty.

Groundnuts

81. The season at Mount Makulu was favourable for groundnuts and with early planting, yields ran up to over 1,900 lb. per acre of kernels. The later the planting the more the yield dropped. The variety Mani Pintar which has shown promise over the past two years continues to do well. It was used as the standard of comparison in three variety trials, one of mainly runner types, one of bunch type, and one of " Early bunch " types, and topped the list on each occasion. A red self-coloured reselection is almost up to the yield level of the Mani Pintar parent stock in which the striped colouring of the seeds might well be a disadvantage on the market. This red Mani Pintar is now being bulked for distribution.

82. Fertiliser trials on groundnuts at Mount Makulu and in the districts gave inconclusive results. Cultivation method and plant population density had little effect on yield this season either at Mount Makulu or in the districts, but a reduction in potential yield due to insufficient weeding or to no weeding was spectacular in a trial repeated at four centres. The widespread phenomenon of empty pods or " pops " in the groundnut crop continues to baffle the investigators. Plant Breeders and Chemists and others making a concentrated attack on the problem can only say that trace element deficiency or imbalance has some far-from-simple relationship with " pops ". *Cercospora* leafspot on the susceptible varieties again proved amenable to control by such fungicides as Zineb and Maneb in particular with a consequent marked increase, as much as 750 lb. per acre kernels. Fungicide application on a variety more tolerant of leafspot gave no significant increase in yield.

Pulses

83. Soya beans do well in the field, but are unpopular as a crop for local consumption because of difficulties in processing and cooking; *Phaseolus vulgaris* beans by contrast are popular but yield badly and store badly. It is nothing exceptional to obtain yields well over 1,000 lb. per acre with soyas and the leading variety this season on Mount Makulu, Hernon No. 279, yielded at 1,200 lb. per acre in spite of delay in planting. A soya trial at Misamfu in the Northern Province showed the large response of 500 lb. per acre to the application of phosphates. *Phaseolus* beans yielded in the range of 400–600 lb. per acre, being much affected by bean-fly except for the type Nanziande where a yield of over 900 lb. per acre indicates that the bean-fly might jib at this possibly unpalatable variety.

Wheat

84. Testing of wheat selections from crosses progressed well and selections from Kentana 51B show promise of resistance to the blight *Helminthosporium sativum* which is a major restraint on the yield of rain-fed or summer-season wheat. Weeds constitute another main drawback to the successful growing of wheat in the rains; summer wheat has not so far given any worthwhile yield on a field scale although carefully nursed small plots have yielded up to eight bags to the acre. The use of fungicides has improved the yield of comparatively resistant as well as *Helminthosporium* susceptible summer varieties, and further tests will be made. Results from trials of cultivation methods and weed-killers were spoilt by particularly severe lodging caused by storms at the time of heading. Stem-rust was unimportant on summer wheat (*Helminthosporium* is much more to be feared) but on wheat sown on seepage sites between the season of summer-wheat and winter-wheat was severe enough in conjunction with bird damage to lead to disappointing yields of about four bags to the acre. Experience continues to indicate that winter production is more promising than summer (rain-fed) or autumn (" seepage ") production. Yields of twelve bags to the acre under irrigation at Mount Makulu were not remarkable, but the better selections now coming forward from the breeding work hold greater promise. The yields of irrigated winter-wheat on the Nanga Polder scheme ranged up to seventeen bags to the acre. Observation plots of summer wheat at two localities in the Northern Province gave yields at the rate of 7.2 bags at Old Fife and five bags at Kasama per acre.

Other Grains and Oilseeds

85. Selection of sorghum varieties for high yielding capacity is beginning to show results, and the best selection in trials on Mount Makulu gave grain yields up to 3,000 lb. per acre.

Crossing to combine malting quality and resistance to bird damage has apparently given the desired combination within a small F2 generation; but the resistance of some varieties may well be relative and not absolute. Bird damage has been more severe on dwarf early-maturing sorghums planted very early in the season than on such types planted a few weeks later; the potential yield may be heavier with the earlier planting, but the concentration of birds on the first available sorghum vitiates for once the general recommendation to plant nearly all crops as early as possible in the season for best results. Testing of sorghum varieties is making headway in the provinces.

86. Local finger millet (*Eleusine corocana*) varieties gave better yields than varieties introduced from India and Ceylon. No increase in yield was obtained by drilling the rows closer than twenty-four inches apart; the wider rows have an obvious advantage in aiding control of weeds, an important operation in the husbandry of finger millet. Bearded varieties of bulrush millet (*Pennisetum typhoides*) apparently escaped bird damage only when naked types were present and the quelea population low.

87. *Sesamum indicum* gave low yields, only two varieties out of thirty-nine bettering 200 lb. to the acre. *S. angolense* which grows wild in Northern Rhodesia gave with added nitrogen a yield per acre of just over 450 lb., the response to nitrogen being 170 lb. A ton of *S. angolense* seed was collected from around Mount Makulu and sent to the Kenya Pyrethrum Board during the year.

AGRONOMY

Soil Fertility

88. A start was made on a long-term fertility trial intended as a source of biometric data and as a measure of the comparative effect on maize yields of fertilisers, farmyard manure, green manure, rotational cropping, continuous cultivation and cultivation interrupted by rest under grass. This trial, which is to be repeated in the provinces, should provide increasing information over the years on which to base recommendations for sustained high farming. In its first year maize gave the anticipated response to ammonium sulphate, the unfertilised yield of 13.7 bags per acre being raised to 20.4 bags by the addition of 50 lb. nitrogen per acre. The overall yield of groundnuts was 1,737 lb. per acre kernels with no consistent response to fertilisers. Farmyard manure at five tons per acre gave yield increases in maize of the same order as from the fertiliser. A green-manuring trial was also laid down using Mount Makulu as one of the sites of an experiment planned by the Federal Ministry of Agriculture. Maize yields over a range of other trials varied considerably. A straight maize fertiliser trial showed no response to superphosphate but a response to nitrogen that was linear up to 100 lb. nitrogen (500 lb. ammonium sulphate) per acre, at which level the yield was 26.3 bags per acre as against 9.6 bags for the unfertilised treatment. Nitrogen at 100 lb. per acre also nearly doubled the production per acre of crude protein in maize harvested for silage at ten weeks old. Maize in common with most other crops showed a dramatic drop in yield with delay in planting.

Cotton

89. Cotton yields on Mount Makulu were variable from trial to trial. In one trial the yield was 1,220 lb. per acre of seed-cotton planted at the start of the rains and dropped to 990, 678 and 224 lb. with successive three-week delays in planting. Spraying with insecticides probably increased yields though the season was one of comparatively light insect attack, the American bollworm, *Heliothis armigera* being the only pest of much severity. The one untreated half-acre of cotton on the station, however, gave as good a yield as its treated neighbour some short distance away. The heaviest yield on the station came from a variety trial with an overall average at the rate of 2,156 lb. of clean seed-cotton per acre; the leading strain was a Nyasaland variety of Albar 637, with just over 2,600 lb. per acre, and this variety also showed up well at the three provincial sites where variety trials (sprayed) were laid down and where the yields averaged 1,436, 915 and 1,036 lb. per acre of seed-cotton respectively. The lowest yielder in the Mount Makulu trial was variety 9L34 at 1,800 lb. per acre. This has been the stock strain of the Rhodesias until now and with its small boll and prolific fruiting habit has been a very useful strain in the presence of heavy insect attack, but it is now to be replaced by the better yielding and better quality Albar 637 which has also the advantage of appreciable resistance to bacterial blight (*Xanthomonas malvceraraum*). In the districts a series of paired half-acre plots, with one of each pair treated with insecticide and the other left untreated, gave encouraging yields at over a dozen centres covering the Territory. Yields from the sprayed plots ranged from 600 lb. per acre of seed-cotton to over 1,700 lb. per acre, and spraying on the average increased yields by some 25 per cent. These district tests are being repeated with modification in 1959–60.

Tobacco

90. Half an acre of Burley tobacco, an air-cured type suited to the heavier soils, was grown at Mount Makulu and yielded at the rate of between 850 and 1,380 lb. per acre of cured leaf according to fertiliser treatment. An outbreak of wildfire disease (*Pseudomonas tabacum*) was brought under control by spraying with " Agromycin 100 ". The crop, which was grown largely to gain experience in the handling of this type of tobacco preliminary to the start of experimental work, was classified as average for quality. *Ad hoc* experiments on such points as date of planting, fertiliser rates and plant population are in train at many sites in the districts with two main types of Turkish tobacco, Samsun and Soluk.

PLANT PATHOLOGY

91. A number of observations on disease incidence and control have been mentioned under the crops concerned. Many potato varieties were grown and recorded for disease status, especially for resistance to late blight (*Phytophthora infestans*). The disease situation on plants in general followed its usual pattern of development, with insect pests prominent at the beginning of the rains and fungous and other diseases more conspicuous as the season advanced. A severe yellowing of maize associated with slow growth in times of heavy rains was widespread in parts of the Central Province (including Mount Makulu) and was noticeably like the disease associated with zinc deficiency in parts of South Africa; it is being further investigated. Corn root-worm of maize appears to be on the increase and this season it was reported not only from the Southern Province, where it was first noted several years ago, but from the Central Province also. Maize streak virus was again widespread. In Turkish tobacco frogeye (*Cercospora*) was the most serious disease of the year but anthracnose (*Colletotrichum*) was present as a disease in fields as well as in seedbeds, while rosette was unusually abundant and mildew was locally serious. An eelworm survey being carried out in co-operation with the Nematologist of the Federal Department of Agriculture was continued and a chapter written in conjunction with him may be incorporated in a supplement to a Check List of Diseases being produced by the Commonwealth Bureau of Mycology. Many botanical specimens were collected during the year in collaboration with Dr. Robson of Kew on behalf of the Flora Zambesiaca.

IRRIGATION AND DRAINAGE

92. Specialist officers continued to co-operate with the staff of the Kafue Pilot Polder of the Rhodesian Selection Trust. Summer crops grown on the polder during the 1958–59 rainy season were not successful and the reasons for the failure of rice, a crop which could be expected to thrive under these conditions, are being investigated. Wheat was successfully grown in winter under irrigation though much remains to be done to improve yield and quality if a return commensurate with the costs of development is to be reached. A good deal of work has been done on the adaptation of irrigation technique to these extreme conditions. Indications are that surface irrigation with accurate grading and levelling may be superior to sprinkler irrigation, but there is much to be learnt about soil management. A Rhodes grass pasture under sprinkler irrigation was established and cattle brought into it. The grass, after being top-dressed with 400 lb. per acre of sulphate of ammonia in early spring and then irrigated at the rate of three inches every ten days, responded well and the thirty head of stock kept in this twenty-acre field could not keep pace with the growth, heavy cutting being required after each grazing period. Four model peasant farms, two irrigated by sprinklers and two by flooding, have been established to provide information on the problems likely to be encountered by African farmers under these conditions. An exploratory hole sunk at the site of these farms revealed sand-bearing water underlying the stiff clay at shallow depth, and following this a number of test holes have been put down on the Kafue Flats in the neighbourhood of the polder to find how far this formation extends.

93. The Senior Agricultural Officer advised on many minor irrigation schemes throughout the country. He has given much attention to the subject of erosion from unsuitable earth roads in rural districts, and has advocated methods of road construction and alignment which he is now putting into practice in the Ngwesi River valley as part of the regional planning of that catchment unit.

ANIMAL HUSBANDRY

94. The programme of animal husbandry and pasture research formerly carried out under the direction of the Chief Veterinary Research Officer at the Mazabuka Central Research Station was transferred to the control of this department during the year. The main work carried on in this field at Mazabuka over the past few years comprises a nucleus breeding experiment with three types of cattle indigenous to tropical Africa, climatological studies on African cattle, studies on the growth and nutrition of African cattle under local conditions and studies of the effect of grazing by cattle on the natural grassland.

95. The nucleus breeding experiment is designed to measure the capacity for improvement of two Northern Rhodesian types, the Ngoni (which belongs to the East African Zebu group) and the Barotse (a long-horned Sanga type), and an East African Zebu type indigenous to Kenya, the Boran. A fourth group of small short-horned Sanga cattle, the Tonga or Mashukulumbwe which are local to the central part of Northern Rhodesia, was originally included but rejected early in the experiment as showing less capacity for improvement than the others. During the year the first appearance in numbers of the F2 generation of calves was made from matings of selected bulls to thirty Boran and forty-four Ngoni selected heifers. Altogether the 271 females in the scheme produced 202 calves (nearly 75 per cent. calving rate) out of which twenty-five bull calves were selected for proving.

96. The work on climatic adaptation of African cattle resulted in the preparation of two papers on the characteristics of the skin and sweat glands. It was found that there is little difference in skin thickness between cattle indigenous to the tropics and those of the temperate zone, but the structure and in particular the sweat glands show considerable differences.

The superior heat tolerance of the Zebu seems to be largely due to their possession of very large sweat glands. In the course of these investigations it appeared that accepted methods of defining heat tolerance in cattle are not reliable indicators of the ability of cattle to withstand continuous high temperatures. Study of the growth and nutrition of indigenous cattle has revealed a faculty which they have for the virtual cessation of skeletal growth during periods of adverse nutrition, which enables them to withstand hard conditions without undue strain. Investigation is proceeding on the effect of supplementing the natural level of nutrition. It has also been found that indigenous cattle have a greater intake of food and a more rapid passage of food through the gut than exotic cattle, and this may help to explain their observed ability to extract their requirements from large quantities of material of low nutritive value. The digestive juices of these cattle appear to be more saline than those of exotic cattle, and exotic cattle kept in Northern Rhodesia have a higher salt content in the gut than the same types of cattle in the temperate regions. It is suggested that the beneficial effect of a dry season salt supplement might be the maintenance of suitable conditions in the rumen for the digestion of materials high in cellulose content. Supplementation studies indicate that a protein or carbohydrate supplement (1½ lb. groundnut meal or 2 lb. maize meal per head per day through the dry season) produced no effect alone, but in combination they produced a substantial liveweight gain and a still greater gain with the addition of 1 oz. of salt per day. The addition of an iron and copper supplement produced a further gain, and analysis of the blood minerals of cattle on the station in July and October brought out an indication that while all essential elements were present in adequate amounts in July, the October figures showed iron deficient and copper, sodium and chlorine barely adequate.

97. In addition to the work on the Mazabuka station an attempt was made during the year to assess the reproductive rate of cattle in the African areas by examination of statistics in each province. While the figures obtained were not complete enough to produce conclusive indications they suggest that most cows in the African areas calve only in alternate years and there is a high calf mortality. Poor nutrition is suggested as the main cause, aggravated by lack of control over breeding which results in many calves being born in the dry season when the keep is insufficient to ensure a good milk flow in the dam. It is suggested also that there are too few bulls. These observations must clearly be followed up.

CHEMISTRY

98. In the Soils Division, 7,120 determinations were carried out on soils and on miscellaneous agricultural samples such as farmyard manure and lime. Methods of routine soil analysis remain unchanged, but some new acquisitions including absorption and flame spectrophotometers should speed the work considerably, and the laboratory has been extended to bring all the chemists under one roof. A large backlog of samples from the territorial soil survey awaiting analysis has now been worked off and it has thus been possible to give more attention to the techniques of pot and micro-plot experiments, to specialised field problems such as " pops " in groundnuts and to the investigation of the usefulness of biological assay for phosphorus status of the soil.

99. In the course of herbage analysis nearly 8,000 determinations were made during the year. It was shown that the phosphate content of grasses fell markedly with increasing maturity of the plant, but that cutting at frequent intervals in simulation of grazing preserved phosphorus at a near-maximum level. Some fourteen introduced grasses studied showed considerably higher concentrations of most mineral elements in the early part of the season. Six indigenous grass species have shown, over two seasons, extremely low sodium contents even in the early stages of growth, and low phosphorus and chlorine contents; but calcium, magnesium and sulphur appear to be adequate for livestock needs. Herbage from Livingstone area where stock were suffering from suspected trace element deficiency showed so little copper that symptoms of copper deficiency in the cattle would certainly be expected. Variants on the techniques for analysing trace elements were tried, and the fitting up of a trace element room in the extension to the chemistry laboratory should allow of work on a larger scale and of greater precision. Now that experimental steers are available it is hoped to start on digestibility trials in the near future.

THE FARM AT MOUNT MAKULU

100. During the year the farming at Mount Makulu was reorganised in such a way that the experiments could so far as practicable " lose themselves in the farming ". A six field rotation of three years Rhodes grass and three years arable cropping has been adopted as the basis of the farming system. Production on this portion of the station is to be made as intensive as possible and the farm fields are to be used for a building up and final inspection of desirable crop types such as Mani Pintar groundnuts, and " synthetic " maize which has now reached the stage of field testing, while the grass phase will be used for experiments with cattle. Some arable land has had to be left out of the main stream of the farming, where for instance long-term residual effects are to be measured or where a multiplicity of crops is included in one experiment. Tie-ridging is being given a field scale try out as a method of soil conservation. The back-blocks of the farm consisting largely of broken scrub country are to be developed to carry a ranch herd to provide animals for experimentation.

CONCLUSION

101. This may possibly be the last report on agriculture in Northern Rhodesia signed over the title of Director of Agriculture. The post is not one of great antiquity but its past holders over a period of thirty years or so have built up an organisation for scientific and technical services to farmers which is playing its part in the development and conservation of the rural areas of the Territory. The demand now coming from the people in those areas for agricultural services is a gratifying sign of confidence in the services provided. There can never be enough resources for all that is required in a country of this size with so many development needs, nor should it be overlooked that technical services alone cannot be translated into production unless there is the improvement in communications, marketing, rural education, water supplies and so forth, required to expand the agricultural economy, and provision of capital for farm development. The aim of the department has been to supply an efficient and well-balanced service to as many as possible of the people who can profit by it, and to support advisory staff with appropriate investigational facilities. If these services have been of value during the past year, as I believe they have, much credit is due to the staff, whose loyalty, enthusiasm and confidence in the future of African agriculture have never flagged in a year when the spotlight has been so much on political affairs.

C. E. Johnson,
Acting Director of Agriculture.

Lusaka,
27th February, 1960.

APPENDIX I

CROP PRODUCTION

African Maize Sales in 1959

	Bags of 200 lb.
Sold to Grain Marketing Board agents in controlled areas:	
Southern Province	274,500
Central Province	182,500
Eastern Province	53,500
Sales direct to Board	5,700
	516,200
Sold to other buyers outside controlled areas:	
Southern Province	12,000
Northern Province	14,000
Other areas	10,000
Grand Total ...	552,000

Sales of Maize in the Controlled Areas, 1955–59

(Thousands of bags of 200 lb.)

	European	*African*			*Total*
Year		*Line of rail*	*Eastern Province (a)*	*Total Bought*	*Delivered line of rail*
1955 ...	... 606	309	134	443	1,039
1956 ...	... 900	586	148	734	1,634
1957 ...	... 1,176	832	83	915	2,073
1958 ...	... 543	45	11	56	599
1959 ...	... 1,028	463	53	516	1,531

(*a*) Includes local sales in Eastern Province although not a controlled area before 1958.

Sales of Groundnuts, 1959

	Bags of 180 lb.
Eastern Province	66,280
North-Western Province ...	5,430
Other areas (estimated) ...	2,280
	73,990

Eastern Province Groundnut Sales, 1955–59

(Bags of 180 lb.)

Harvest year	*Fort Jameson*	*Petauke*	*Lundazi*	*Total*
1955 ...	36,312	15,937	915	53,164
1956 ...	38,794	22,437	5,400	66,631
1957 ...	42,795	18,721	3,000	64,516
1958 ...	22,466	12,542	5,641	40,649
1959 ...	34,023	13,348	18,910	66,281

African Burley Tobacco Sales: Eastern Province

Harvest year	*Quantity sold lb.*	*Average price Pence per lb.*
1950 ...	264,000	26.69
1951 ...	192,000	20.4
1952 ...	24,000	28.22
1953 ...	20,696	29.56
1954 ...	44,774	25.97
1955 ...	6,876	25.12
1956 ...	6,890	18.29
1957 ...	12,154	34.87
1958 ...	19,688	18.18
1959 ...	29,647	22.09

African Turkish Tobacco Sales

	Quantity sold lb. weight	*Average price Pence per lb.*
1956 ...	12,000	25.9
1957 ...	17,000	34.2
1958 ...	45,853	31.4
1959 ...	58,381	34.9

APPENDIX II

CLIMATIC RECORDS, 1958–59

RAINFALL (IN INCHES)

	1958	1959						
	Oct.	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Total*
Mount Makulu ...	0.64	4.32	9.93	8.11	9.51	1.39	0.56	—	35.85
Lusaka mean ...	0.42	3.61	5.91	9.06	7.45	5.61	0.68	0.06	32.80
Monze	—	2.33	11.87	5.03	7.25	2.58	0.19	0.15	29.40
Mean	0.83	2.88	7.07	8.17	7.62	4.16	0.59	0.05	31.37
Choma	2.17	2.14	11.49	6.94	7.61	1.86	0.44	0.65	33.30
Mean	1.19	3.80	7.11	7.76	8.43	3.66	0.97	0.65	33.58
Ndola	1.25	6.35	7.88	2.27	10.37	3.49	2.12	0.03	33.76
Mean	0.72	5.50	9.87	13.83	10.39	9.20	1.31	0.08	50.90
Fort Jameson ...	0.39	3.47	5.36	10.03	11.32	2.35	0.58	0.04	33.54
Mean	0.35	3.85	8.28	10.67	10.09	6.14	1.94	0.18	41.29
Petauke	0.14	2.94	5.33	13.89	11.69	3.47	0.22	0.01	37.69
Mean	0.52	3.40	7.41	10.70	10.14	5.10	0.33	0.33	37.53
Lundazi	0.07	2.17	13.22	8.67	7.98	5.59	1.64	—	39.34
Mean	0.14	2.16	6.93	8.79	8.24	6.80	0.90	0.20	34.16
Kasama	—	4.89	8.06	9.26	10.20	5.95	2.95	—	41.31
Mean	0.62	6.06	9.78	11.07	9.90	10.59	3.04	—	51.09
Fort Rosebery ...	2.25	7.09	9.16	5.97	5.25	6.55	0.35	—	36.62
Mean	1.05	5.34	7.68	7.63	9.29	6.68	2.00	0.12	39.83
Broken Hill ...	1.39	2.21	9.99	5.96	16.67	5.28	0.25	—	41.75
Solwezi	2.33	9.62	11.28	10.58	10.15	4.26	3.65	0.15	52.02
Balovale	3.92	3.28	6.68	7.23	14.45	5.55	—	0.02	41.13
Mongu	1.73	6.73	10.65	6.47	13.85	5.01	1.15	0.45	46.04
Mankoya	2.23	3.65	13.84	10.84	20.10	7.51	—	0.68	58.91

TEMPERATURES (IN °F.)

Mount Makulu:								
Mean max. ...	85.6	87.1	80.6	80.6	77.8	79.5	81.2	81.4
Mean min. ...	63.4	64.5	63.6	62.8	64.0	60.3	58.6	55.0
Fort Jameson:								
Mean max. ...	90.8	90.2	84.2	82.3	80.4	82.1	83.3	83.9
Mean min. ...	64.9	68.1	67.5	65.0	64.9	65.2	62.3	62.2

APPENDIX III

STAFF

DISTRIBUTION OF STAFF AS AT 31ST DECEMBER, 1959

Post	*Authorised establishment*	*Employed* (a)	(b)	(c)	(d)	*Total*
Director	1*	—	—	—	—	—
Deputy Director	1	1	—	—	—	1
Chief Research Officer	1	1	—	—	—	1
Chief Agricultural Officers	3	3	—	—	—	3
Agricultural Officers	33	5	19	3	—	27
Agricultural Officers (Supernumerary)	4					
Agricultural Economist	1	—	—	1	—	1
Animal Husbandry Officer	1	—	—	1	—	1
Assistant Tobacco Adviser	1	—	1	—	—	1
Conservation Officer	1	—	—	1	—	1
Principal Agricultural Supervisors	8	—	7	1	—	8
Agricultural Supervisors	46	—	41	3	—	44
Agricultural Supervisors (Supernumerary)	6	—	2	—	—	2
Livestock Officers	3	—	3	—	—	3
Ecologist	1	—	—	1	—	1
Agricultural Chemists	2	—	—	2	—	2
Soil Chemist	1	—	—	1	—	1
Plant Breeders	3	—	—	3	—	3
Plant Pathologist	1	—	—	1	—	1
Pasture Research Officers	2	—	—	2	—	2
Entomologist	1	—	—	—	—	—
Assistant Professional Officer	1	—	1	—	—	1
Farm Superintendent	1	—	—	1	—	1
Research Assistants	4	—	—	4	—	4
Assistant Technical Officers	2	—	1	1	—	2
Mechanic	1	—	—	—	1	1
Clerks (Male)	8	—	—	—	7	7
Clerks (Female)	9	—	—	—	9	9
Clerks (Female Supernumerary)	2	—	—	—	2	2
AFRICAN STAFF						
Clerks	53	—	—	—	51	51
Agricultural and Veterinary Assistants	397	—	332	15	—	347
Survey Assistants	10	—	—	8	—	8
Laboratory Assistants	9	—	—	9	—	9
Agricultural Capitaos	228	—	209	10	1	220
Veterinary Orderlies and Stockmen	4	—	2	1	—	3
Senior Orderlies and Orderlies	57	—	—	—	56	56
Telephone Operator	1	—	—	—	1	1

* Director of Agriculture acting as Secretary to the Ministry from 29th June.

(a) Employed on administration at Headquarters or provincial level.

(b) Employed on advisory duties.

(c) Employed on investigational work.

(d) Employed on clerical and general duties.

APPENDIX IV

LEGISLATION

The following legislation affecting African Agriculture was enacted during the year 1959:

African Farming Improvement Funds Ordinance (No. 66 of 1957).

Government Notice No. 130 of 1959—African Farming Improvement Funds (Levy) Order, 1959.

Government Notice No. 131 of 1959—African Farming Improvement Funds (Levy) No. 2 Order, 1959.

Government Notice No. 200 of 1959—The African Farming Improvement Funds Ordinance—Designation of authority, Minister of African Agriculture.

African Grain Marketing (Deductions) Ordinance, 1958.

Government Notice No. 141 of 1959—African Grain Marketing Deductions.

APPENDIX V

PUBLICATIONS

The following departmental Bulletins and Reports were published during the year:

C. A. Smith, m.agr.sc.

Studies on the Northern Rhodesia *Hyparrhenia* Veld, Part I. The Grazing Behaviour of Indigenous Cattle grazed at light and heavy stocking rates. *J. Agr. Sci.*, 52, 369–375.

R. Webster, m.sc., and J. K. R. Gasser, b.sc., m.sc.

Soil Nitrogen v. Leaching of Nitrate from Soils in Laboratory Experiments. *J. Sci. Food Agric.*, 10, 584 (1959).

K. F. Salmond, b.sc., ph.d., d.i.c., f.r.e.s.

Bulletin No. 16—A Guide to the Safe Storage of Maize.

In addition to these papers several other papers were submitted to various journals during the year but have not yet been published.

APPENDIX VI

EXPENDITURE FROM AFRICAN FARMING IMPROVEMENT FUNDS, 1958–59

	Southern	*Central*	*Eastern*
	£	£	£
Bonuses to improved farmers	40,551	15,496	9,906
Subsidies on seeds, fertilisers and equipment	20,071	6,235	6,258
Soil conservation (including village lands improvement) ...	48,472	3,929	1,695
Water supplies and conservation	10,089	3,735	—
Buildings and equipment additions	18,134	—	—
Depreciation and maintenance of buildings and equipment ...	7,691	6,136	460
Administration and sundries	3,783	2,594	2,438
Total	£148,791	£38,125	£20,757